Engagement Opportunities in NASA STEM 2023 (EONS-2023)
NASA Research Announcement (NRA)
MUREP Space Technology Artemis Research (M-STAR)
Number: NNH23ZHA001N-MSTAR

Title: Protective Thermal Electro-Chromic Coatings (ProTECC) for Lunar Exploration

Institution: University of North Texas

City/State: Denton, Texas

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FY: 2023

Summary: Objectives: The Moon's environment involves both extreme temperature swings and a dusty landscape. The research goal of the proposed activity is to manufacture and characterize advanced heat transfer coatings for simultaneous autonomous heat management and dust mitigation of spacecraft. This dual-purpose technology can allow increased thermal performance, weight reduction, environmental resiliency, and simpler spacecraft structures for future Artemis exploration missions. These activities will increase the lead MSI's laboratory and workforce capabilities in spacecraft hardware development and testing.

The education enrichment goal is to offer students, especially those who from socioeconomically underserved backgrounds in the North Texas area access to scholarships, workshops, and internships at NASA Centers and the lead MSI. Students recruited to this project will be mentored to pursue STEM career paths towards space exploration. The broader goal of this project is to inspire the public interest in NASA missions and build a talented and diverse STEM modern workforce that can strengthen our Nation's lead in Lunar and Mars exploration and space technologies.

Methodologies: This project applies the physical mechanisms and operation principles of electronic-optical refractory oxides, magnetoplasmonics, optical diffraction, and dipolar dynamics of adhesion to create a simultaneous thermal management and dust mitigation device. Preliminary investigations show that an innovative combination of resilient electro-chromic materials and micro-patterning techniques can lead to a versatile and scalable microns-thin thermal control coating that permits high contrast radiative heat switching. The low voltage tunability of the coating can replace actively-controlled thermal radiators. A top-layer passive micropatterned surface can both minimize dust adhesion and control heat absorption or dissipation.

This project will recruit promising students at an early stage and encourage them to pursue STEM career paths towards space exploration. Financial and career incentives are offered for high-achieving students in need. Promising undergraduate students are recruited for NASA summer internships. An annual scholarship is awarded to undergraduates who demonstrate strong academic performance and passion for aerospace engineering. This project will establish an aerospace engineering fundamentals course, a high school summer machining workshop, and

prototyping and characterization research projects. North Texas area students' and the public's interests in space are heightened via student-led professional society hosting of public lectures featuring NASA experts, poster symposia, and promotion of internship opportunities.

Relevance: Our activities will strengthen the research infrastructure and capabilities at UNT. The research is relevant to Artemis because adaptable thermal and dust control across a multitude of critical mission components can assure astronauts' living space comfort, exploration and haptic accessibility, and containment of exposure health risks. These outcomes enhance the lead MSI's competitiveness for acquiring future funding from NASA and other government agencies. This project will inspire and train students to pursue and advance career opportunities towards space technologies and exploration through various education programs.